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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/878,820	06/11/2001	Shiqun Gu	01-096	3179

7590 08/12/2002

LSI LOGIC CORPORATION
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EXAMINER
DEO, DUY VU

ART UNIT	PAPER NUMBER
1765	

DATE MAILED: 08/12/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

mk - 2

Office Action Summary	Application No.	Applicant(s)	
	09/878,820	GU ET AL.	
	Examiner	Art Unit	
	DuyVu n Deo	1765	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *11 June 2001* .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-20* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-20* is/are rejected.

7)☒ Claim(s) *13 and 20* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (e) the invention was described in-
> (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effect under this subsection of a national application published under section 122(b) only if the international application designating the United States was published under Article 21(2)(a) of such treaty in the English language; or
> (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that a patent shall not be deemed filed in the United States for the purposes of this subsection based on the filing of an international application filed under the treaty defined in section 351(a).

2. Claims 1, 3, 4, 5 are rejected under 35 U.S.C. 102(e) as being anticipated by Liu et al. (US 6,323,121).

Liu describe a method for forming a conductive via comprising: forming a via cavity in a first dielectric to expose a first conductive layer; etching the via with a hydrogen-containing plasma including H2; forming a liner, such as TiN as a barrier, in the via; forming a second conductive layer adjacent the liner layer and substantially filling the via (col. 6, line 50-col. 7, line 30).

Referring to claim 3, the hydrogen-containing plasma would also remove any carbon and oxygen from a residue on the first conductive layer in the via. Referring to claim 5, using CVD to deposit any material including TiN is well known to one skilled in the art at the time of the invention (please see Wang et al. below).

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. Claims 6, 7, 11, 12, 15, 17-19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Liu as applied to claim 5 above, and further in view of Wang et al. (US 6,365,495).

Unlike claimed invention, Liu doesn't describe an isotropic plasma treatment of the liner layer before formation of the second conductive layer. Wang teaches a method of forming the liner, TiN, where he teaches of a plasma treatment of the TiN with H2 and N2 gases (col. 10, line 10-68). This would read on claimed isotropic plasma treatment of the TiN. It would have been obvious for one skilled in the art to modify Liu's method in light of Wang's plasma treatment because it would decreases resistivity, increases purity, densifies, and improves stability of the TiN as a barrier.

5. Claims 2, 16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Liu or Liu/Wang as applied to claims 1 and 11 above, and further in view of Bersin et al. (US 5,882,489).

Unlike claim 2, Liu doesn't describe a step of Ar sputtering before depositing the liner to remove residue on the conductive layer. Bersin teaches a method of cleaning a via and conductive layer in the via using Ar sputtering (col. 3, line 33-35; col. 4, line 28-31; col. 5, line 5, line 8-10). It would have been obvious for one skilled in the art to modify Liu's in light of Bersin's cleaning method because the Ar sputtering cleaning step would remove insoluble and nonvolatile residues off the conductive layer in the via.

6. Claims 8, 9, 13, 14, 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Liu or Liu/Wang as applied to claims 1 and 11 above, and further in view of Lin et al. (US 6,133,143).

Referring to claims 8 and 13 using a Ti/TiN layers in the process of forming metal interconnect is well known to one skilled in the art as shown here by Liu to form barrier/diffusion layer (col. 4, line 35-48). Lin also describe other metal layer such as W can be used to fill the via hole (col. 4, line 51). Therefore, at the time of the invention, using other metal including W to fill the via hole would have been obvious to one skilled in the art to form a conductive plug with an expect of reasonable success.

7. Claim 10 is rejected under 35 U.S.C. 103(a) as being unpatentable over Liu, Lin, Wang, and Bersin.

Liu describe a method for forming a conductive via comprising: forming a via cavity in a first dielectric to expose a first conductive layer; etching the via with a hydrogen-containing plasma including H2; forming a liner, such as TiN as a barrier, in the via; forming a second conductive layer adjacent the liner layer and substantially filling the via (col. 6, line 50-col. 7, line 30). The hydrogen-containing plasma would also remove any carbon and oxygen from a residue on the first conductive layer in the via. Unlike claimed invention, Liu doesn't describe a Ti is formed under the liner TiN; however, using a Ti/TiN layers in the process of forming metal interconnect is well known to one skilled in the art as shown here by Liu to form barrier/diffusion layer (col. 4, line 35-48). Lin also describe other metal layer such as W can be used to fill the via hole (col. 4, line 51). Therefore, at the time of the invention, using other metal including W to fill the via hole would have been obvious to one skilled in the art forming a

barrier of Ti/TiN and a conductive plug in the via to form an interconnect with an expect of reasonable success.

Unlike claimed invention, Liu doesn't describe a step of Ar sputtering before depositing the liner to remove residue on the conductive layer. Bersin teaches a method of cleaning a via and conductive layer in the via using Ar sputtering (col. 3, line 33-35; col. 4, line 28-31; col. 5, line 5, line 8-10). It would have been obvious for one skilled in the art to modify Liu's in light of Bersin's cleaning method because the Ar sputtering cleaning step would remove insoluble and nonvolatile residues off the conductive layer in the via.

Unlike claimed invention, Liu doesn't describe an isotropic plasma treatment of the liner layer before formation of the second conductive layer. Wang teaches a method of forming the liner, TiN, where he teaches of a plasma treatment of the TiN with H2 and N2 gases (col. 10, line 10-68). This would read on claimed isotropic plasma treatment of the TiN. It would have been obvious for one skilled in the art to modify Liu's method in light of Wang's plasma treatment because it would decreases resistivity, increases purity, densifies, and improves stability of the TiN as a barrier.

Claim Objections

8. Claims 13 and 20 are objected to because of the following informalities: they are the same and depend on the same claim. Appropriate correction is required.

9. Any inquiry concerning this communication or earlier communications from the examiner should be directed to DuyVu n Deo whose telephone number is 703-305-0515.

DVD
August 8, 2002

JEFFRIE R. LUND
PRIMARY EXAMINER